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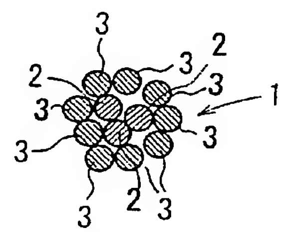
(54) CORDE HYBRIDE ET PRODUIT EN CAOUTCHOUC
(54) HYBRID CORD AND RUBBER PRODUCT

(57)
A hybrid cord (1) as a rubber reinforcing cord having excellent dimensional stability and flexible performance and a rubber product reinforced with the hybrid cord, comprising glass fiber strands (2) at the center thereof and aramid fiber strands (3) around the glass fiber strands, wherein a plurality of strands of RFL treated glass fiber filaments are first twisted and a plurality of RFL treated aramid fiber filaments are bound into several strands and the strands are first twisted, the glass fiber strands (2) are disposed at the center and the aramid fiber strands (3) around the glass fiber strands are finally twisted in the direction reverse to the direction of the first twisting, and a rubber coating is formed on the fiber strands by an overcoat treatment.



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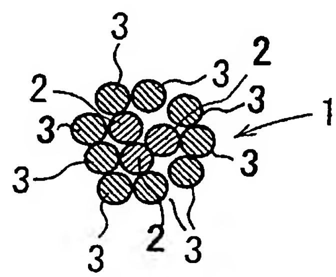

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A hybrid cord (1) as a rubber reinforcing cord having excellent dimensional stability and flexible performance and a rubber product reinforced with the hybrid cord, comprising glass fiber strands (2) at the center thereof and aramid fiber strands (3) around the glass fiber strands, wherein a plurality of strands of RFL treated glass fiber filaments are first twisted and a plurality of RFL treated aramid fiber filaments are bound into several strands and the strands are first twisted, the glass fiber strands (2) are disposed at the center and the aramid fiber strands (3) around the glass fiber strands are finally twisted in the direction reverse to the direction of the first twisting, and a rubber coating is formed on the fiber strands by an overcoat treatment.

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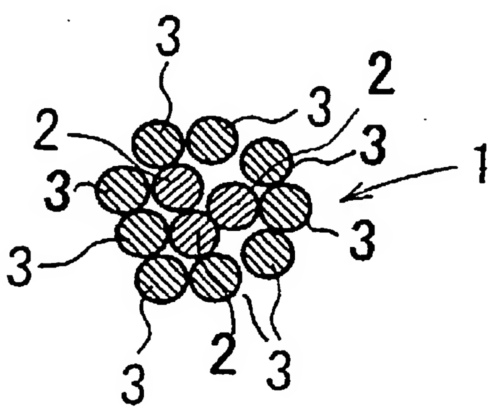

(57) Abstract: A hybrid cord (1) as a rubber reinforcing cord having excellent dimensional stability and flexible performance and a rubber product reinforced with the hybrid cord, comprising glass fiber strands (2) at the center thereof and aramid fiber strands (3) around the glass fiber strands, wherein a plurality of strands of RFL treated glass fiber filaments are first twisted and a plurality of RFL treated aramid fiber filaments are bound into several strands and the strands are first twisted, the glass fiber strands (2) are disposed at the center and the aramid fiber strands (3) around the glass fiber strands are finally twisted in the direction reverse to the direction of the first twisting, and a rubber coating is formed on the fiber strands by an overcoat treatment.

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(57) 要約:

ゴム補強用コードとして、寸法安定性、屈曲性能に優れたハイブリッドコードと、これにより補強されたゴム製品が提供される。ハイブリッドコード１は、中央のガラス繊維ストランド２と、周囲のアラミド繊維ストランド３とを有する。ＲＦＬ処理されたガラス繊維フィラメントからの複数本のストランドが下撚りされ、ＲＦＬ処理されたアラミド繊維フィラメントが複数本数束ねられて下撚りされる。ガラス繊維ストランド２が中央に配置され、周囲にアラミド繊維ストランド３が下撚りと逆方向に上撚りされる。さらに、オーバーコート処理により、ゴム被膜が形成される。

HYBRID CORD AND RUBBER PRODUCT

Field of the Invention

The present invention relates to a hybrid cord having excellent flexing resistance and dimensional stability for use in a reinforcement of rubber products such as a rubber belt and a tire, and also relates to a rubber product reinforced with the hybrid code.

Description of the Related Art

Reinforcement fibers are embedded into rubber products including a rubber belt and a rubber tire, in order to improve strength and durability of the rubber products.

Examples of the reinforcement fibers include a glass fiber, a polyvinyl alcohol fiber such as a vinylon fiber, a polyester fiber, a polyamide fiber such as nylon and aramid, i.e., aromatic polyamide, a carbon fiber, a polyparaphenylene benxoxazole fiber and the like. The glass fiber and the aramid fiber are suitable, and are widely used.

A rubber reinforcing cord made of the glass fiber has high dimensional stability, but has lower retention of strength when it is bent by a small diameter pulley for a long time than that of a rubber reinforcing cord made of the aramid fiber. On the other hand, the aramid fiber cord has good flexing resistance, but has poor dimensional stability

as compared with the glass fiber cord.

SUMMARY OF THE INVENTION

A hybrid cord of the present invention comprises at least one glass fiber strand, and a plurality of aramid fiber strands twisted together, wherein the glass fiber strand is disposed at a center of the hybrid cord, and the aramid fiber strands are disposed around the glass fiber strand.

According to the present invention, there is provided a hybrid cord having excellent flexing resistance and dimensional stability, and a rubber product reinforced with the hybrid cord.

As described above, when the aramid fiber cord is made into a belt, it has higher flexural fatigue resistance, but lower dimensional stability than that of the glass fiber cord. On the other hand, the glass fiber cord has excellent dimensional stability, but has lower flexural fatigue resistance than that of the aramid fiber cord. The hybrid cord of the present invention has both of the dimensional stability of the glass fiber cord and the flexural fatigue resistance of the aramid fiber cord.

In order to improve the flexing resistance of the rubber reinforcing cord, the strands of the cord are twisted.

When the rubber belt reinforced with the rubber

reinforcing cord is bent, the cord is strongly compressed at a contact side with the pulley as the diameter of the cord is greater, and at the opposite side, the cord is strongly stretched. Accordingly, in the glass fiber cord , when the diameter of the cord is smaller, a difference between the compression and the stretch can be small, thereby improving the flexing resistance.

The aramid fiber cord has greater elongation than that of the glass fiber cord, and therefore has poor dimensional stability as compared with the glass fiber.

The hybrid cord of the present invention comprises the glass fiber strands having good dimensional stability as a core material, and the aramid fiber strands disposed around the core material. The aramid fiber strands are prevented from elongating by the core material comprising the glass fiber strands. Thus, the hybrid cord of the present invention has excellent dimensional stability. The aramid fiber strands disposed around the core material provide their excellent flexing resistance to the cord.

According to the hybrid cord of the present invention, the glass fiber strands are disposed only at a center of the cord. A plurality of the glass fiber strands collected may be used as the core. In order to improve the flexing resistance of the cord, the glass fiber cord has preferably a small diameter.

A rubber product of the present invention comprises rubber and the aforementioned hybrid cord embedded within the rubber. The rubber product preferably contains 10 to 70% by weight of the hybrid cord.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view of a hybrid cord according to an embodiment of the present invention;

Fig. 2 is a schematic perspective view showing a method of producing the hybrid cord; and

Fig. 3 is an illustration of a method of flexural fatigue test in Examples and Comparative Examples.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figures, preferred embodiments will be described below. Fig. 1 is a sectional view of a hybrid cord according to an embodiment, and Fig. 2 is a schematic perspective view showing a method of producing the hybrid cord.

As shown in Fig. 1, the hybrid cord 1 includes at least one glass fiber strand 2 disposed at a center of a cross-section perpendicular to a longitudinal direction of the cord 1, and a plurality of aramid fiber strands 3 disposed therearound.

Filaments of glass fibers for use in the glass fiber

strand may be an E glass fiber filament, and a high strength glass fiber filament.

An aramid fiber for use in the aramid fiber strands may be a para-aramid fiber or a meta-aramid fiber. Filaments of the para-aramid fiber are available from Teijin Limited under the trademark of "TECHNORORA" which is copolyparaphenylene-3,4'-oxydiphenylene terephthalamide, and from Teijin Twaron Limited under the trademark of "Twaron" which is polyparaphenylene terephthalamide. Filaments of the meta-aramid fibers are available from Teijin Limited under the trademark of "CONEX", which is polymethaphenylene isophthalamide. It is noted that the aramid fiber is not limited thereto.

As shown in Fig. 2, the hybrid cord 1 is produced using a guide 6 having a center guide hole 4, and peripheral guide holes 5. Each peripheral guide hole 5 is disposed at approximately equal distance from the center guide hole 4.

Inside and edge of each hole 4, 5 are composed of ceramic with smooth surface. The plurality of glass fiber strands 2 primarily twisted are passed through the center guide hole 4, and the aramid fiber strands 3 primarily twisted are passed through the peripheral guide holes 5. These strands 2, 3 are properly twisted together to provide the hybrid code 1. It is preferable that a twisting rate in the proper twist be about 1 to 10 turns / 25 mm.

In the present invention, the glass fiber filaments applied with treatment RLF are preferably bound to form the strands, and the predetermined number of lines of strands are primarily twisted together at the twisting rate of 1 to 10 turns / 25 mm. A predetermined number of lines of the aramid fiber filaments also applied with RLF treatment are preferably bound and primarily twisted at the twisting rate of 1 to 10 turns / 25 mm.

The RFL treatment is conducted by immersing the filaments into a treating liquid (hereinafter referred to as "RFL") comprising a mixture of an initial condensation product of resorcin and formalin and rubber latex as a main component, and then heating them. Non-limiting examples of the rubber latex for use in the RFL treatment include acrylic rubber based latex, urethane based latex, styrene - butadiene rubber based latex, nitrile rubber based latex, chlorosulfonated polyethylene based latex, modified latexes thereof, and a mixture thereof.

According to the present invention, a rubber coat may be formed on a surface of the hybrid cord produced as shown in Fig. 2. Thus, the hybrid cord may be overcoated with rubber in order to enhance affinity between the cord and a rubber product. As the rubber of the overcoat, hydrogenated nitrile rubber, chlorosulfonated polyethylene rubber, chloroprene rubber, natural rubber and urethane rubber and

the like can be used. In many cases, the same rubber as that to be molded into a product is used. The overcoat rubber employed is not especially limited thereto.

The hybrid cord of the present invention is suitably used in reinforcing a belt, i.e., a moving belt, a crawler, and other rubber members. It is preferable that about 10 to 70% by weight of the hybrid cord is contained in the rubber product.

EXAMPLES

The Examples of the present invention will be described below.

EXAMPLE 1

Three high strength glass fiber strands comprising 200 lines of filaments each having a fiber diameter of 7 μm were grouped together without being twisted. The strands were applied with RFL treatment using an RFL containing chlorosulfoanted polyethylene based latex so that an RFL deposition was about 25% by weight on a solid basis.

Aramid fiber filaments each having a fiber diameter of 12 μm and 400 denier manufactured by Teijin Limited under the trademark of "TECHNORORA" were applied with RLF treatment so that an RFL deposition was about 25% by weight on a solid basis similar to the glass fiber filaments.

The glass fiber filaments treated with RFL and the

aramid fiber filaments treated with RFL were primarily twisted at a twisting rate of 2 turns / 25 mm respectively to provide glass fiber strands and aramid fiber strands.

Then, three glass fiber strands were passed through the guide hole 4 at the center of the guide 6 shown in Fig. 2. Eight aramid fiber strands were passed through eight guide holes 5 at a peripheral part of the guide 6 shown in Fig. 2, respectively. These were properly twisted at a twisting rate of 2 turns / 25 mm in the opposite direction to that of the primary twist. Thus, there was provided a properly twisted glass fiber - aramid fiber hybrid naked cord in which the three glass fiber strands were disposed at the center, and the eight aramid fiber strands were disposed therearound.

The thus-obtained properly twisted naked cord was overcoated with an overcoat treating liquid containing chlorosulfonated polyethylene rubber and chloroprene rubber, in order to further improve adhesion with the matrix resin, resulting in a glass fiber - aramid fiber hybrid cord.

The resulting glass fiber - aramid fiber hybrid cord has elongation at break of 4.60%.

Then, the glass fiber - aramid fiber hybrid cord was pressed and heated together with the hydrogenated nitrile rubber (hereinafter referred to as HSN) to form an HSN rubber molded product in which single glass fiber - aramid

fiber hybrid cord was embedded.

The HSN rubber molded product was cut so that the glass fiber - aramid fiber hybrid cord was at the center of the rubber molded product, whereby a belt-shaped molded product with a width of 10 mm was formed.

As shown in Fig. 3, the belt-shaped molded product 10 was set on a testing machine comprising a flat pulley 11 with a diameter of 25 mm, a motor 12 and four guide pulleys 13, and was hung over the pulleys 11, 13. The belt 10 was reciprocated by the motor 12, and was bent repeatedly at a part along the flat pulley 11. The belt 10 was applied with initial tension of 20N and then bent 100,000 times at room temperature. After bending, the strength and the retention of strength of the belt 10 were determined for evaluating flexural fatigue resistance thereof.

As a result, the belt had the strength of 880 N and the retention of strength of 87% after bending.

EXAMPLE 2

The RLF treatment was conducted similar to Example 1 except that the RFL deposition on the glass fiber filaments and the aramid fiber filaments was about 20% by weight on a solid basis. Respective fiber filaments were primarily and properly twisted, and overcoated similar to Example 1. Four glass fiber strands and seven aramid fiber strands were used to produce the glass fiber - aramid fiber hybrid cord

similar to Example 1. The hybrid cord was used to produce the rubber belt similar to Example 1.

The resulting hybrid cord had elongation at break of 4.52%. As a result of the flexural fatigue test, the rubber belt had the strength of 845 N and the retention of strength of 83% after bending.

EXAMPLE 3

The same operation was conducted similar to Examples 1 and 2 except that the RFL deposition on the glass fiber filaments and the aramid fiber filaments was about 15% by weight on a solid basis. Five glass fiber strands and six aramid fiber strands were used to produce the glass fiber - aramid fiber hybrid cord similar to Example 1. The hybrid cord was used to produce the rubber belt similar to Example 1.

The resulting hybrid cord had elongation at break of 4.56%. As a result of the flexural fatigue test, the rubber belt had the strength of 820 N and the retention of strength of 80% after bending.

COMPARATIVE EXAMPLES 1 to 3

As to Comparative Example 1, three glass fiber strands and eight aramid fiber strands that were the same as Example 1 were randomly twisted together to produce the cord. As to Comparative Example 2, a cord was produced by using eleven glass fiber strands. As to Comparative Example 3, a cord

was produced by using eleven aramid fiber strands alone. Elongation at break of each cord was measured. Respective belt products formed by using respective cords were tested for the strength and the retention of strength after bending. These results are shown in TABLE 1.

	Twist conditions	Elongation at break of cord (%)	Strength after bending of belt (N)	Retention of strength after bending of belt (%)
Example 1	Center: three glass fibers, Peripheral: eight aramid fibers	4.60	880	87
Example 2	Center: four glass fibers, Peripheral: seven aramid fibers	4.52	845	83
Example 3	Center: five glass fibers, Peripheral: six aramid fibers	4.56	820	80
Comparative Example 1	Random twisted, Three glass fibers, Eight aramid fibers	5.23	740	73
Comparative Example 2	Eleven glass fibers	4.48	630	60
Comparative Example 3	Eleven aramid fibers	6.62	905	93

Table 1

As is apparent from TABLE 1, the glass fiber - aramid fiber hybrid cord of the present invention has excellent elongation at break similar to the glass fiber cord of Comparative Example 2, and excellent flexing resistance similar to the aramid fiber cord of Comparative Example 3. The belt-shaped molded product formed using the glass fiber - aramid fiber hybrid cord has excellent strength and

retention of strength after bending similar to the aramid fiber cord. Comparative Example 1 has poor elongation, strength and retention of strength as compared with Examples 1 to 3.

INDUSTRIAL AVAILABILITY

As aforementioned, according to the present invention, there is provided a hybrid cord having excellent flexing resistance and dimensional stability, and a rubber product reinforced with the hybrid cord.

WHAT IS CLAIMED IS:

1. A hybrid cord, comprising at least one glass fiber strand, and a plurality of aramid fiber strands twisted together,

wherein the glass fiber strand is disposed at a center of the hybrid cord, and the aramid fiber strands are disposed around the glass fiber strand.

2. A hybrid cord according to Claim 1, wherein the glass fiber strand and the aramid fiber strands are primarily twisted at a twisting rate of 1 to 10 turns / 25 mm, respectively.

3. A hybrid cord according to Claim 1 or 2, wherein the glass fiber strand that is primary twisted and the aramid fiber strands that is primary twisted are properly twisted together at a twisting rate of 1 to 10 turns / 25 mm.

4. A hybrid cord according to any one of Claims 1 to 3, wherein both of the glass fiber and the aramid fiber are subjected to an RFL treatment.

5. A hybrid cord according to Claim 4, wherein the RFL treatment is conducted by immersing filaments into a

treating liquid comprising a mixture of an initial condensation product of resorcin and formalin and rubber latex as a main component, and then heating them.

6. A hybrid cord according to Claim 5, wherein the rubber latex is at least one selected from the group consisting of acrylic rubber based latex, urethane based latex, styrene - butadiene rubber based latex, nitrile rubber based latex, chlorosulfonated polyethylene based latexes, and modified latexes thereof.

7. A hybrid cord according to any one of Claims 4 to 6, wherein the RLF treatment liquid is deposited on the hybrid cord in an amount of 5 to 30% by weight on a solid basis.

8. A hybrid cord according to any one of Claims 1 to 7, further comprising a rubber coat for overcoating the hybrid cord.

9. A hybrid cord according to Claim 8, wherein the rubber coat is at least one selected from the group consisting of hydrogenated nitrile rubber, chlorosulfonated polyethylene rubber, chloroprene rubber, natural rubber and urethane rubber.

10. A hybrid cord according to Claims 8 or 9, wherein the rubber coat is deposited on the hybrid cord in an amount of 2 to 10% by weight.

11. A reinforced rubber product comprising rubber and a reinforcing cord embedded within the rubber, wherein the cord is the hybrid cord according to any one of Claims 1 to 10.

12. A reinforced rubber product according to Claim 11, wherein 10 to 70% by weight of the hybrid cord is contained.

Fig.1

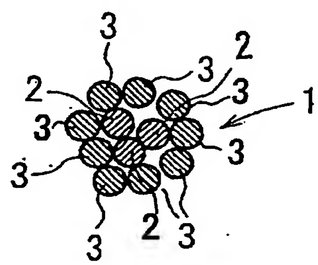

Fig.2

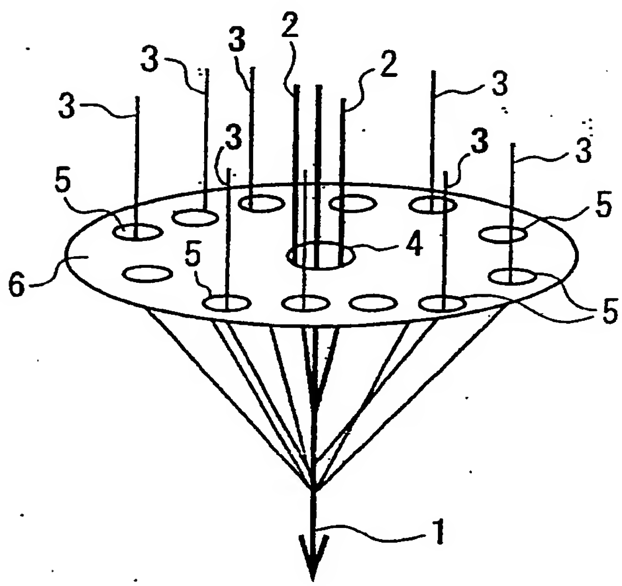

Fig.3